THE COMMON FROG*

II.

BEFORE passing on to an enumeration of the subordinate groups of the sub-kingdom Vertebrata, we may first revert to our subject, the Frog, and make further acquaintance with it.

The common frog of this country belongs to the genus *Rana*, and it is the species *Temporaria*, therefore its scientific name is *Rana temporaria*. It is common in Ireland, as well as in England and Scotland, and is indeed the most widely distributed species of the frog-order, being found throughout the temperate regions of both the Old and New Worlds. It is found over nearly the whole of Europe; in Africa north of the Sahara, and in Egypt; in Northern Asia, including Japan and Chusan, and it is also spread over North America. It is not found in the northern half of Scandinavia, nor in Iceland.

Except in winter, the common frog is generally in England so familiar an object, that any description of it might seem superfluous. The purpose in view, however, renders it needful at least to recall certain external structural characters both of the adult and the immature condition.

The head and body of the frog together forms an elongated oval mass, somewhat pointed at each end, of which mass the head constitutes rather more than one-third. This mass is more or less flattened both above and below, except at the commencement of the hinder third of the back, where there is a more or less marked prominence, which indicates the junction of the haunch bones with the spine. In front of this the only marked projections are those of the eyeballs.

The short arms project outward on each side just behind the head, and each ends in a small hand with four fingers, the second of which is the shortest, and the third the longest. When the arm is turned backwards this third finger barely attains (if it can do so at all) the hinder end of the body.

The hind limbs proceed from quite the hinder end of the body, there being no vestige of a tail. The thigh is very muscular, and the leg has a good "calf." The foot is exceedingly long, and what is very remarkable, is so jointed that the toes can be sharply bent upwards on its thick and undivided part. The latter thus seems to form a third segment of the hind limb following the thigh and the leg, the limb having four segments instead of three as in ourselves, and in almost all beasts, birds, and reptiles.

The foot ends in five toes connected by a web. Of these the fourth is the longest, the first the shortest. On the inner margin of the sole of the foot, at the root of the first toe, is a small, hard prominence, called a "tarsal tubercle." When the hind limb is turned forward, the knee reaches nearly to the armpit; the ankle-joint is about on a line with the end of the snout, and both parts of the foot beyond it. These two parts of the foot together are much longer than the whole fore limb, and exceed two-thirds of the length of the whole mass of the head and body.

When the animal is viewed in profile, the point of the muzzle is seen to be very little in advance of the opening of the mouth. The latter is straight. It is also very wide, extending back even beyond the hinder margin of the eye. Just above the hinder angle of the gape, and behind the eye, is a rounded surface of smooth, tightly-stretched skin. This is called the "tympanum," and directly covers in the drum of the ear.

When the mouth is opened, if the finger be drawn along the inner margin of the upper jaw, a series of minute teeth may be detected. Towards the front of the palate are a pair of small holes (which are the inner openings of the nostrils), and between these are two juxtaposed little groups of other minute teeth. There are no teeth whatever in the lower jaw. At the hinder end of each side of the palate is another small hole. These latter two apertures are each the opening of a canal leading from the mouth to the cavity of the ear within the drum. The tongue is seen to be large, flat, and fleshy. It is tied down to the jaw in front, but free for more than its hinder half, with the processes developed from its free hinder margin.

The skin of the frog is naked and smooth, without a trace of scales, or other appendages. Its colour on the upper surface is more or less yellowish, or reddish brown, with irregular black, brown, or grey patches. Similar patches form transverse bands upon the legs. Beneath the colour is pale yellowish, often with a few spots, paler than those of the back. There is constantly a brownish black subtriangular patch placed behind the eye, and extending over the tympanum down towards the shoulder. The frog breathes partly by swallowing air (aided by a mechanism to be described hereafter), partly by the direct respiratory action of the skin. It feeds exclusively upon living animals, such as insects and slugs, which it catches by suddenly throwing forwards beyond the mouth, the free hinder half of the tongue (furnished with an adhesive secretion), and then retracting it with its prey in a most rapid manner.

In winter the frog passes into that torpid state known as *hibernation*, as is the case with our bats, hedgehogs, and some other beasts. Its season of torpidity is generally passed by it buried in mud and at the bottom of water, and great numbers of individuals may be dug up in winter all clustered together.

In spring the frogs again congregate for the purpose of oviposition in the month of March, at which period their well-known croaking makes itself heard, and though in itself unmelodious, possesses a certain charm through its association with the vernal outburst of nature.

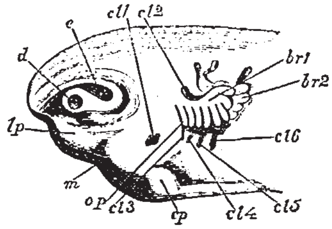

FIG. 3.—View of left side of head of Embryo Tadpole (after Parker). br^1 and br^2, first and second external branchiæ; cl^1—cl^5, the six viceral clefts; *cp*, the left "holder"; *d*, the olfactory organ; *e*, the eye; *lp*, th left lip; *m*, the aperture of the mouth; *op*, the hinder margin of the rudimentary operculum.

When first laid, the frog's eggs are little round dark bodies enclosed in no solid shell or case, but in a small glutinous envelope. The latter quickly swells in the water so much that the "spawn" comes to have the appearance of a great mass of jelly through which dark specks (the yolks of the egg) are scattered. Each egg, when microscopically examined, may be seen to undergo a process of yolk sub-division and cleavage till a mulberry-like mass is formed. Upon this soon appears the "primitive groove," which forms a canal and develops beneath it a "chorda dorsalis" according to the process which has been already stated to be common to the whole of the Vertebrata.

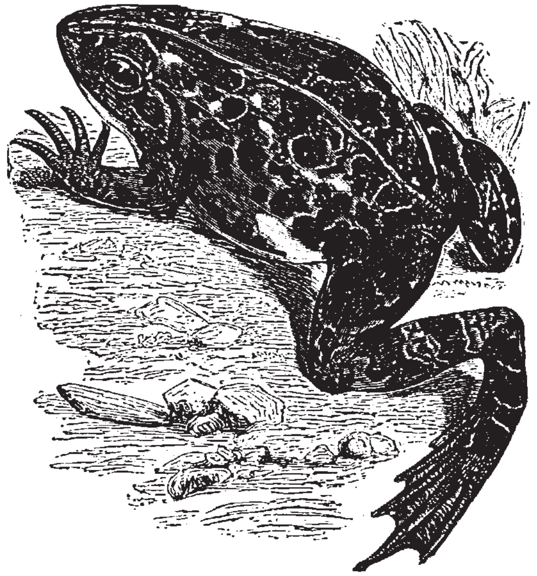

FIG. 4.—The Edible Frog (*Rana esculenta*).

Gradually the embryo assumes the form of a young tadpole, and is provided with a pair of little "holders" (or organs for adhesion) just behind the mouth, with six openings on each side of the neck (Fig. 3, cl^1–cl^6), and with a pair of rudimentary external gills (Fig. 3, br^1 and br^2). These openings are termed "visceral clefts," which lead from the exterior into the throat, as already described. The solid pillars (or intervals) between the clefts, *i.e.*, the "visceral arches," become furnished with gills,[*] or *branchiæ*, and are therefore called "branchial arches." The eggs are hatched towards the end of April, and the tadpole emerges in the stage represented at Fig. 2, 1. It has a relatively large head, a rounded body, and a long tail, by lateral undulations of which the little creature swims about. From behind the head, on each side, jut forth external branchiæ as a small plume-like structure, but no limbs are visible.

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* Continued from p. 471.

As the tadpole grows the external plumose gills at first greatly enlarge (Fig. 2, 2 and 2*a*), but afterwards become gradually absorbed, and are succeeded by short gill-filaments, which are developed along each of the branchial arches. These latter filaments do not appear externally, and indeed a membrane, termed the operculum (Fig. 3, *op*), is developed from the front of each series of branchial apertures, and which, extending backwards by degrees, ultimately covers over and conceals them.

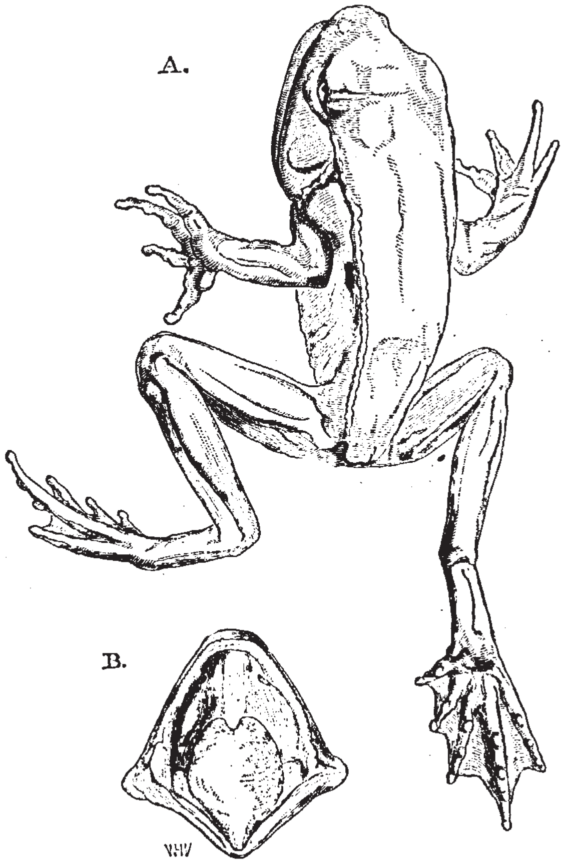

FIG. 5.—A, *Pachybatrachus robustus*, nat. size; B, interior of the mouth of ditto.

Little by little the limbs bud forth and grow, the hind ones being the first visible because the fore limbs are for a time concealed by the opercular membrane. As the legs grow, the tail becomes absorbed (Fig. 2, 7), not falling off, as some suppose. The gills also disappear, and the branchial apertures close, that on the right side first becoming obsolete by adherence of the operculum to the skin of the body.

As the gills diminish and cease to serve the purposes of respiration, lungs at the same time become developed in an inverse ratio, and the tadpoles absolutely require to come to the surface to breathe.

The process, from the hatching to the acquisition of the miniature form of the adult, may be accelerated or retarded by elevation or depression of the temperature. The frog more than doubles its bulk in its first summer.[*] The young tadpole has at first a very small mouth placed beneath the head and not at its anterior termination; it is also for a time provided with a sort of beak formed of two little horny jaws.

The food of the tadpole, quite unlike that of the adult, consists largely (especially in its earlier stages) of vegetable substances.

Having now made acquaintance with the Frog considered absolutely, or by itself, and also clearly seen that it is a member of the Vertebrate Sub-kingdom, we may enumerate the principal primary sub-divisions (Classes) of that Sub-kingdom, and enumerate such of the next smaller groups (Orders) as more or less nearly concern the subject of this work—the Frog.

The Vertebrata are divided into five great Classes:—(I), *Mammalia* (Man and Beasts); (II.), *Aves* (Birds); (III.), *Reptilia* (Reptiles, *i.e.* Crocodiles, Lizards, Serpents, and Tortoises); (IV.), *Batrachia* (Amphibians, *i.e.* Frogs, Toads, Efts, &c.); and (V.), *Pisces* (Fishes).

Of these five classes Birds and Reptiles are classed together in a larger group called *Sauropsida*, because they present so many structural resemblances. Similarly Amphibians and Fishes are grouped together, and to their united mass the common term *Ichthyopsida* is applied.

FIG. 6.—The Common Toad (*Bufo vulgaris*)

The orders into which the two classes, Mammalia and Aves (beasts and birds), are divided, may here be neglected, as we shall have little to say respecting them in the following pages. There are, however, about twelve orders of beasts, and probably some fourteen of birds.

The class of Fishes has been subdivided into five Orders.

1. Elasmobranchii (the sharks and rays, or highly organised cartilaginous fishes).
2. Ganoidei, an important order, containing many extinct forms, and a few very varied existing ones, such as the mud-fish (Lepidosiren), ceratodus, and the sturgeon.
3. Teleostei, the ordinary or bony fishes, such as the carp, sole, perch, &c., and containing a remarkable group called Siluroids, as also the curious little sea-horse—Hippocampus.
4. Marsipobranchii (the lamprey and myxine, or lowly organised cartilaginous fishes).
5. Pharyngobranchii (the amphioxus, or lancelet).

Reptiles are arranged in nine different orders, five of which are now entirely extinct. They are of living forms:—

1. Crocodilia (crocodiles).
2. Sauria (lizards, the Amphisbenæ, the little Flying-dragon, &c.)
3. Ophidia (serpents).
4. Chelonia (tortoises and turtles).

Of extinct kinds there are:—

5. Ichthyosauria; 6, Plesiosauria; 7, Dicynodontia; 8, Pterosauria; and 9, Dinosauria.

The remaining class, Batrachia, will require more lengthy consideration, both as a whole and as regards the four orders which compose it, and which are called respectively, 1, Anoura; 2, Urodela; 3, Ophiomorpha; and 4, Labyrinthodonta.

It will require such consideration, because it is the class to which the Frog itself belongs.

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[*] Gills (or branchiæ) are delicate processes of skin richly supplied with minute blood-vessels, wherein the blood becomes exposed to the purifying action of the air dissolved in the water.

[*] Parker, Phil. Trans., 1871, p. 172.

The Frog belongs to the Batrachian order *Anoura*, to the family *Ranidæ*, and to the genus *Rana*.

The order Anoura, to which all frogs and toads belong, is a remarkably homogeneous one, consisting as it does of a multitude of species, all differing from each other by comparatively trifling characters.

Altogether there are about 600 species of frogs and toads, arranged in about 130 different genera.

St. George Mivart

(*To be continued.*)

*JEAN CHACORNAC**

THIS eminent French astronomer died on the 6th of last September, having been born at Lyon, June 21, 1823. Chacornac is chiefly known for his discoveries among the planetoids whose orbits are contained between those of Mars and Jupiter. In his earlier years he devoted himself to commerce, but having, in 1851, made the acquaintance of M. Valz, Director of the Marseilles Observatory, Chacornac became an enthusiastic student of astronomy, devoting himself to research in connection with the solar spots and to the assiduous exploration of the heavens. On his discovery of a new comet on May 15, 1852, he made up his mind to abandon commerce and devote himself entirely to astronomy.

In 1852, M. Valz, following the example of Mr. Hind, had drawn some charts of the region of the heavens in which the small planets were likely to be met with, and on Chacornac taking the above decision, Valz entrusted to him the construction of the "Atlas écliptique." Chacornac commenced his observations on the region of the small planets on June 1, 1852, and on September 20 he discovered Massalia, and on April 6, 1853, Phocæa, and that with an equatorial telescope of only thirteen centimetres aperture.

The poor resources which were at the disposal of the Marseilles Observatory did not permit of M. Valz's undertaking the publication of the ecliptic charts; and for this purpose he addressed the Academy of Sciences, which had appointed a commission to examine the question. M. Le Verrier, who at this time sought to reform the *personnel* of the Paris Observatory, called to his aid M. Chacornac, who, on March 4, 1854, was appointed Adjoint Astronomer.

At the Observatory of Paris, Chacornac had at his disposal an equatorial of 7 in. aperture, equal to that of Mr. Hind; he set down in his charts stars up to the 13th magnitude, and the limits which they embraced were at the same time somewhat extended. The publication commenced very soon after, and from 1854 to 1863, thirty-six charts, of which some contained not less than 3,000 stars, were put into the hands of astronomers.

During the construction of these charts, Chacornac discovered many small planets—Amphitrite (March 3, 1854), Polymnia (October 28, 1854), Circe (April 6, 1855), Lydia (January 12, 1856), Lætitia (February 8, 1856), Olympia (September 12, 1860). At the same time he observed all the comets which were then visible and defined, with the telescope of Foucault, of 80 centimetres, many spiral nebulæ, previously studied by Herschel. The drawings of M. Chacornac are among the most careful we possess, and appear to show that nebulæ of this kind undergo in time slight variations of form.

This collection of remarkable works brought to the Astronomer of the Paris Observatory many academic and honorary rewards: thus, he obtained the Lalande Prize in 1852, 53, 54, 55, 56, 60, and 1863, became titular astronomer February 22, 1857, and Chevalier of the Legion of Honour, August 15, 1857.

His labours, however, and their attendant anxieties, told upon his health. After going to Spain, where he went to observe the total eclipse of the sun of July 18, 1860, the ecliptic charts were issued less frequently, and in June, 1863, he quitted the Observatory to retire to Ville Urbanne, in the suburbs of Lyon.

In his country retirement, M. Chacornac, whose spirit had preserved all its activity, constructed with his own hands a telescope of three metres focus, by means of which, until within the last few months, he assiduously observed the solar spots and their manifold transformations. In the description of their incessant changes he sought new proofs of the gaseous nature of the sun, an idea which he was one of the first to announce.

SCIENCE LECTURES AT CAMBRIDGE

THE following Lectures in Natural Sciences will be given at Trinity, St. John's, and Sidney Sussex Colleges during Michaelmas Term, 1873:—

On General Physics and Mechanics. By Mr. Trotter, Trinity, in Lecture Room No. 11 (Monday, Wednesday, Friday, at 11, commencing Wednesday, Oct. 15).

On Elementary Organic Chemistry. By Mr. Main, St. John's (Tuesday, Thursday, Saturday, at 12, in St. John's College Laboratory, commencing Thursday, Oct. 16). Instruction in Practical Chemistry will also be given.

On Palæontology (the Protozoa and Cœlenterata). By Mr. Bonney, St. John's (Tuesday and Thursday at 9, commencing Thursday, Oct. 16).

On Geology for the Natural Sciences Tripos. Preliminary matter and Petrology. By Mr. Bonney, St. John's (Monday, Wednesday, and Friday, at 10, commencing Wednesday, Oct. 15.) A Course on Physical Geology will be given in the Lent Term, and on Stratigraphical Geology in the Easter Term.

Papers will be given to Questionists every Saturday at 11, but the first paper will be set on Wednesday, Oct. 15, at 11, when arrangements will be made for further instruction should it be required.

On Botany, for the Natural Sciences Tripos. By Mr. Hicks, Sidney (Tuesday, Thursday, Saturday, at 11, in Lecture Room No. 1, beginning on Thursday, Oct. 16). The Lectures during this term will be on the Morphology of Phanerogamia.

A Course of Practical Physiology and Histology. By the Trinity Prælector in Physiology (Dr. Michael Foster) at the New Museums. Lectures on Tuesday, Thursday, Saturday, at 12, commencing Saturday, Oct. 25.

This course is intended for those who have gone through a course of Elementary Biology similar to that given last Easter Term.

THE AMERICAN ASSOCIATION

THE Portland Meeting of the American Association for the Advancement of Science was in almost every respect an exceptional success. Its general attendance was very large, and there was an unusual number of the older members, whose presence insures consideration of the more important topics, and gives dignity and force to the discussions. An especial effort had been made to exclude all inferior communications. A regulation had been adopted, compelling the presentation of an abstract of each paper before it was read; and the examining committee in determining from abstracts what papers should be read, exercised in general a rigorous but wise discretion. It will not be the case after this, as after previous meetings, that a considerable proportion of the communications actually read will have to be ignored in the printed proceedings. But even under such restrictions, the number of papers actually read was unusually

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* From an article in *La Revue Scientifique*, by M. G. Rayet, Chief Astronomer of the Meteorological Service at the Paris Observatory.